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Environment, Health and Safety Division

Work Plan for Closure of the National  
Tritium Labeling Facility (NTLF)

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## **A. Introduction**

On September 14, 2001 the National Institutes of Health (NIH) and Lawrence Berkeley National Laboratory (LBNL) announced that NIH was withdrawing funding for the National Tritium Labeling Facility (NTLF) at LBNL and that NTLF would terminate operations in December 2001 after 19 years of service. This document describes the various activities that will be undertaken as part of the closure of the NTLF to return the laboratory spaces and ancillary facilities to reuse for other purposes.

### **A.1 Responsibility**

Responsibility for safe and orderly closure of the NTLF lies with the LBNL Physical Biosciences Division (PBD). Management of the closure process and work activities is the responsibility of the LBNL Environment Health and Safety Division (EH&S). Oversight of the closure process is the responsibility of the U.S. Department of Energy, Berkeley Site Office (BSO).

### **A.2 Background**

Building 75 was constructed on the LBNL site in the mid 1960's as a special radiation laboratory for use in handling large quantities of tritium, the radioactive isotope of hydrogen, in support of biomedical research being carried out in the Calvin Laboratory on the UC Campus. From the outset, the Building 75 laboratory was equipped with handling and ventilation facilities to support tritium labeling research and operations. From 1982-2001 the NIH funded NTLF as a national user facility for tritium labeling, and research scientists from around the globe came to Berkeley to use this unique facility.

Over its 30+ year history the NTLF received and processed approximately 200,000 Curies (Ci) of tritium. During this entire time the facility has enjoyed an excellent record of safety and environmental performance. The NTLF Safety Analysis Document, prepared in 1996, contains an analysis of the NTLF site, facility, hazard and accident analysis and safety structures, systems and components, technical safety requirements, and radiation protection requirements. The principal hazards associated with the facility are the use and storage of quantities of the radioactive isotope tritium and of hazardous chemicals. Other hazards include electrical hazards, cryogenics, and



magnetic fields associated with nuclear magnetic resonance spectroscopy. The principal safety systems associated with the facility are fire protection, access control, glove boxes and chemical hoods, and ventilation and exhaust systems.

Radiation protection programs and requirements for the NTLF are described in the LBNL Radiation Protection Plan (Rev. 5, Oct.1999). The NTLF Radiological Work Authorization (RWA) contains a detailed description of radiation protection practices for the NTLF; the RWA is reviewed and approved annually by the LBNL Radiation Safety Committee. Environmental monitoring requirements and programs for the NTLF are described in the LBNL Environmental Monitoring Plan (December 2001). Major elements of the environmental program for the NTLF include stack sampling and real-time monitoring and sanitary sewer sampling.

NTLF worker radiation exposures have been monitored by means of urine bioassay, and there have been no recorded tritium exposures to NTLF personnel that exceeded the occupational radiation dose limits of 10CFR835 (formerly DOE Order 5480.11). There have been no fires, explosions, significant releases of hazardous materials, nor any significant safety incident at the NTLF. Stack air emissions of tritium over the 30+ year history of the NTLF have never exceeded the current annual limits of the Environmental Protection Agency under the National Emission Standards for Hazardous Air Pollutants (NESHAPs), and discharges to the sanitary sewer have not exceeded the limits of the East Bay Municipal Utility District. The NTLF has been subjected to numerous safety and environmental reviews over its history and has been found in all reviews to have been operated in full compliance with all applicable regulations and requirements.

### **A.3 Purpose**

The purpose of this work plan is to describe the various activities that will be undertaken as part of the closure of the NTLF to return the laboratory spaces and ancillary facilities to reuse for other purposes. This will include:

- removal of the hazardous chemicals and radioactive materials;
- dismantling and disposition of research apparatus and equipment;
- decontamination and decommissioning (D&D) of laboratory facilities;



- D&D of outdoor facilities; and
- D&D of ancillary spaces.

This work plan also describes work planning and scheduling processes, clean-up standards, health and safety measures, environmental protection considerations, and EH&S Procedures followed in the closure process.

It is intended that this work plan be a living document. As NTLF closure activity plans are solidified, more detail will be added as revisions and/or appendices to the work plan.

#### **A.4 Facility Description**

Information and a picture tour of the NTLF facility is given at <http://www.lbl.gov/LBL-Programs/NTLF/>. Table 1 lists the NTLF facilities and associated closure issues associated with each. The type of radiation protection posting on each facility is also indicated, per EH&S Procedure 709, Radiation Protection Posting, Labeling and Entry Control.

## **B. Approach**

Closure of the NTLF and D&D of NTLF facilities is approached in three phases as outlined in Table 2. Specific work plans for each phase will be added as Appendices as they are developed (see Appendices).

### **B.1 Radioactive Materials and Chemicals**

Removal of chemicals and stock radioactive materials from the NTLF will be performed as the first phase of the closure process.

#### **B.1.1 Tritium Stock**

As part of the NTLF closure process LBNL will transfer the stock supply of tritium used for research at NTLF to the tritium facility at the nearby LLNL lab. Removal and preparations for transfer of tritium from NTLF to LLNL is an activity performed under the NTLF Radiological Work Authorization (RWA 1034). The presence of trained and experienced workers is important for this work



to be carried out with occupational radiation doses and environmental releases maintained as low as reasonably achievable. Further details of the transfer of tritium to LLNL are contained in Appendix 1. [Note added upon issue of revision 2: The transfer of 10,265 Ci tritium from NTLF to LLNL was completed December 20, 2001.]

### **B.1.2 Other Radioactive Materials**

In addition to the stock tritium stored in the NTLF there are a number of tritiated chemicals in storage as well as tritium contaminated wastes. These materials will be managed during the closure activities following standard procedures for managing the materials as appropriate. Some material will be shipped to offsite recipients following EH&S Procedure 750, LBNL Radioactive Material Transportation Program. Other material will be managed as radioactive waste following standard radioactive or mixed waste procedures expressed in EH&S 800-series procedures. Finally, some items may be determined to be nonradioactive and will be released per EH&S Procedure 708, Release of Potentially Contaminated Materials & Equipment. These activities will be carried out during all three phases of the NTLF closure.

### **B.1.3 Chemicals**

Disposition of chemicals from the NTLF will be managed by LBNL's Hazardous Waste Handling Facility. These activities will be carried out consistent with EH&S Procedure 868, Release of Hazardous Waste from Radiological Materials Areas, Publication 3000, and applicable hazardous waste regulations. The NTLF's Chemical Inventory will be used as a starting point for a complete inventory and clean-out of chemicals from the NTLF research labs and storage areas. See Appendix 1 for details.



**Table 1. NTLF Facilities**

Space	Description	Posting* RMA RSA CA	Closure Issues
<b>Indoors</b>			
75-102	NTLF Chemistry Lab	X	<ul style="list-style-type: none"> <li>• Non-rad chemicals</li> <li>• Lab equipment and apparatus</li> <li>• Possible secondary contamination due to workers or objects from other labs.</li> </ul>
75-103	NTLF Tritiation Lab	X	<ul style="list-style-type: none"> <li>• Tritium stock</li> <li>• Tritiation apparatus</li> <li>• Contaminated lab facilities</li> <li>• Tritium contaminated and non-rad chemicals</li> </ul>
75-106	NTLF NMR Lab	X	<ul style="list-style-type: none"> <li>• Non-rad chemicals</li> <li>• Lab equipment and apparatus</li> <li>• LSC counter</li> </ul>
75-107	NTLF Hot Lab	X	<ul style="list-style-type: none"> <li>• Tritium contaminated and non-rad chemicals</li> <li>• Contaminated lab equipment and apparatus</li> <li>• Contaminated lab facilities</li> </ul>
75E	Office trailer	None	<ul style="list-style-type: none"> <li>• Possible secondary contamination (tritium) due to workers</li> </ul>
75-112 B	Calorimeter Lab	X	<ul style="list-style-type: none"> <li>• Probable secondary contamination (tritium) of calorimeter and area due to stored articles</li> </ul>
75-112 C	NTLF Office	None	<ul style="list-style-type: none"> <li>• Possible secondary contamination (tritium) due to workers</li> </ul>
75-117	Rest room	None	<ul style="list-style-type: none"> <li>• Possible secondary contamination (tritium) due to workers</li> </ul>
<b>Outdoors</b>			
75S	NTLF Waste Shed	X	<ul style="list-style-type: none"> <li>• Probable secondary contamination (tritium) due to rad waste storage</li> </ul>
75U	Equipment/Supplies Storage Container	X	<ul style="list-style-type: none"> <li>• Contaminated (tritium) articles</li> <li>• Probable secondary contamination (tritium) due to stored articles</li> </ul>
75-103 outdoors	Equipment Cabinets in Fenced Area	X	<ul style="list-style-type: none"> <li>• Contaminated (tritium) lab equipment and apparatus</li> </ul>
75 roof	HVAC and ductwork	None	<ul style="list-style-type: none"> <li>• Contamination (tritium) on interior and possibly on external surfaces</li> </ul>
75 hillside	Exhaust blower motors, ductwork and hillside stack	None	<ul style="list-style-type: none"> <li>• Contamination (tritium) on interior and possibly on external surfaces</li> </ul>

\*Definition of posting abbreviations:

<b>RMA</b>	Radioactive Material Area	Unsealed radioactive material is used in this area.
<b>RSA</b>	Radiological Material Storage Area	Only sealed radioactive material is used or stored in this area.
<b>CA</b>	Controlled Area	Access is controlled for the purposes of radiation protection. A CA is not an RMA or RSA unless otherwise posted within.
	Contamination Area	Note that there are no routinely posted Contamination Areas in NTLF, defined as an area, accessible to individuals, with tritium contamination over 10,000 dpm/100 cm <sup>2</sup> .



**Table 2. NTLF Closure Activities**

<b>Phase</b>	<b>Activities</b>
1. Remove tritium stock and hazardous chemicals	Removal of the hazardous chemicals and radioactive materials: a. Transfer ~12,000 curies of tritium stock from NTLF to another DOE site. b. Characterize and disposition hazardous chemicals and radioactive waste. Of NTLF's four labs, the two non-radioactive material labs (75-102, 106) will be cleared and released for reuse by the end of phase 1.
2. Dismantle and disposition tritiation apparatus	Dismantling and disposition of research apparatus and equipment. These activities will be planned in detail following shutdown of NTLF research operations. a. Dismantle tritiation apparatus, including vacuum systems, pumps, recovery and recycling apparatus, oxidizers, catalytic oxidation units, other apparatus used directly in NTLF research. b. Assay disassembled apparatus and other NTLF scientific equipment for radioactive contamination and dispose appropriately as waste, or recycle for use in other research.
3. General decontamination and decommissioning (D&D)	Decontamination and decommissioning (D&D) of laboratory support and outdoor facilities. General D&D activities require development of a work proposal and budget to be submitted for approval. The proposal will include all facilities listed in Table 1.

Note: Radiological monitoring of workers, work spaces, and environmental emissions will continue to be monitored throughout the NTLF closure activities. Environmental sampling and surveillance will likewise continue under the ongoing Environmental Restoration Program and the LBNL Environmental Protection Program.

#### **B.1.4 NEPA/CEQA**

Concurrent with Phase 1 activities, NEPA/CEQA documentation for Phase 2 and 3 activities were prepared by LBNL and approved by DOE, as appropriate. The NEPA/CEQA documentation examined NTLF closure activities against program environmental documents and concluded that closure was within the scope of activities covered by program documents and would create no new or substantially more severe significant impacts requiring additional CEQA documentation. For NEPA, DOE approved a categorical exclusion.



## **B.2 Research apparatus**

The dismantling and disposition of research apparatus, instruments and equipment directly involved in tritiation processes will be planned to take place in phase 2 following final cessation of research activities at the NTLF. This includes all tritiation vacuum apparatus, pumps, oxidizers, recycling apparatus, molecular sieves and other equipment directly connected to the tritiation apparatus. See Appendix 2 for details.

NTLF equipment, instruments and apparatus not directly connected to the tritiation apparatus will be surveyed for radioactive contamination and either released for reuse or salvage, or disposed as low level radioactive waste. These activities will take place at varying times through all three phases of the closure activities. Survey and release procedures are described in EH&S Procedure 708, Release of Potentially Contaminated Materials and Equipment.

## **B.3 Laboratory spaces**

The goal of the closure activities is to return NTLF laboratory spaces to reuse for other purposes. This will require decontamination of the facility to acceptable levels of residual tritium, or removal and disposal of all objects that cannot be decontaminated to acceptable levels.

- It is anticipated that all rooms and spaces listed in Table 1 except 75-103 and 75-107 will be returned to reuse after thorough but straightforward surveys to identify any areas of contamination and routine decontamination of any surfaces not meeting the release criterion (see paragraph D. below). Survey, decontamination and release of these spaces will be carried out throughout phases 1,2 and 3 of the closure process.
- The NTLF Tritiation Lab (75-103) and Hot Lab (75-107) may have extensive tritium contamination on laboratory facilities and equipment such as hoods, lab benches, floors, walls, sinks, and HVAC equipment. Those items that cannot be decontaminated to acceptable levels will have to be removed and disposed as low-level radioactive waste before the spaces can be returned to use. These activities are planned to take place during phase 3 of the closure process.



#### **B.4 Outdoor facilities**

The phase 3 D&D plan will include removal and disposal of NTLF outdoor facilities (see Table 1) contaminated with tritium. The rooftop HVAC equipment and ductwork, and the hillside stack and blower motors will be kept in operation through the course of D&D activities inside the NTLF labs. Following this work, and with the concurrence of the appropriate regulatory authorities, the HVAC equipment, ductwork, blower motors and hillside stack will be taken out of service, surveyed and removed. Other phase 3 activities will include assessment and removal as necessary of soil displaced during removal of the hillside stack and underground portion of ductwork. Integrity of NTLF sink drains that lead to the sanitary sewer will be assessed. Results of the assessment will be reported to the LBNL Environmental Restoration Program for follow-up.

### **C. Work Planning and Schedule**

Work planning and scheduling will be done by a project team assembled to manage the closure and clean up of the NTLF. Project team members are listed in Table 3. Project team meetings will be held weekly or biweekly.

Schedule: The preliminary work schedule is as follows:

- Phase 1 activities will begin in December 2001 and are estimated to be completed by spring 2002.
- Phase 2 work planning will begin in December 2001. Phase 2 activities are expected to take place in July - October 2002.
- The scope and content of phase 3 activities will be planned in summer 2002 and a budget proposal for this work will be prepared for submission to for approval. Work activities associated with phase 3 will begin following budget approval.



**Table 3. NTLF Closure Project Team**

<b>Name</b>	<b>Role</b>
Gary Zeman & Robin Wendt	Project Managers
Phil Williams	NTLF Facility Director
Gale Moline	Hazardous Waste Handling Facility Representative
Chris Donahue	Operational Health Physics Group Leader
Ross Fisher	EH&S Liaison to Facilities Management
Mike Schoonover	Compliance Health Physicist
Mike Ruggieri	Environmental Services Group Representative
Dan Kevin	NEPA/CEQA

## **D. Release Standards**

Release standards are defined as the levels of radioactive contamination above which the article or surface must be treated as radioactive and managed in accordance with applicable guidelines, and below which the article or surface may be released from controls and managed as non-radioactive.

EH&S Procedure 708, Release of Potentially Contaminated Materials & Equipment describes release criteria for potentially contaminated materials and equipment at LBNL that is required to be surveyed for radioactivity prior to unrestricted release. The surface contamination release standards in Procedure 708 are taken from Appendix D to 10CFR835, Occupational Radiation Protection. For volume-contaminated material, there is no DOE-authorized release standard; consequently articles may not be released if they contain any detectable volume contamination. DOE has approved minimum detectable levels for assays of bulk contamination in a variety of materials and these are listed in Table 4-2 of EH&S Procedure 708.

Appendix D to 10 CFR835 lists the surface values to be used in identifying the need for posting of contamination areas and the need for surface contamination monitoring and control. The Appendix D value for tritium is 10,000 dpm/100cm<sup>2</sup> for removable contamination. Note that the levels may be averaged over one square meter provided the maximum surface activity in any area of 100cm<sup>2</sup> is less than three times the listed amount (i.e. 30,000 dpm/100cm<sup>2</sup> maximum for removable contamination).



The release levels for tritium contamination contained in DOE Order 5400.5, Radiation Protection of the Public and the Environment (as implemented in the 11/17/95 DOE guidance memo on Application of DOE 5400.5 requirements for Release and Control of Property Containing Residual Radioactive Material) are the same as contained in appendix D to 10CFR835.

The standards for clean-up that will be applied in the NTLF closure process are as follows:

1. No NTLF items or areas will be released unless removable surface contamination by tritium has been reduced to below the level listed in 10CFR835 Appendix D.
2. For surfaces contaminated below 10,000 but above 1,000 dpm/100cm<sup>2</sup>, reasonable effort will be made to decontaminate the articles to as low as reasonably achievable prior to release.
3. Articles or surfaces will be managed as nonradioactive if the removable surface contamination is either:
  - a. below 1,000 dpm/100cm<sup>2</sup>, or
  - b. below 10,000 dpm/100cm<sup>2</sup> provided reasonable effort has been made to reduce the surface contamination to as low as reasonably achievable.
4. For articles with suspected bulk contamination, a sample will be taken for analysis to determine if volume contamination exceeds the minimum detectable activity (MDA) values listed in Table 4-2 of EH&S Procedure 708. Such articles may not be released if there is a measured level of bulk contamination in excess of the listed MDAs.



## **E. Health & Safety**

### **E.1 General Safety Plan**

A General Safety Plan has been prepared which covers workplace hazard issues associate with the NTLF closure. It refers to LBNL and subcontractor policies and procedures.

### **E.2 Radiological Work Authorization (RWA)**

The current NTLF Radiological Work Authorization (RWA) covered research activities and normal support activities during initial phases of the closure process. For example, the following routine activities were carried out in the past under the RWA: removal and transfer of tritium stock to another DOE site, and clean out of routine radioactive wastes from NTLF spaces. The RWA program at LBNL is described in EH&S Procedure 707, Radiological Work Authorization Program.

### **E.3 Radiation Work Permit (RWP)**

Radiation Work Permits (RWPs) are issued at LBNL to cover non-routine operations in radiation controlled areas. RWPs will be prepared as needed to cover closure activities in NTLF spaces and facilities during the closure process. See EH&S Procedure 705, Operational Health Physics Radiation Work Permit Program.

### **E.4 Nonradiation Hazards**

Nonradiation hazards in NTLF spaces include hazardous chemicals, electrical equipment, cryogens, and magnetic fields associated with nuclear magnetic resonance spectroscopy equipment. Workers carrying out activities in which they may encounter these hazards will receive appropriate LBNL training courses prior to beginning the work.

Phase 2 and 3 activities may result in added work hazards such as noise, dust, and asbestos from equipment or surfaces being decontaminated or removed for disposal. Each phase of this work will be reviewed by appropriate EH&S subject matter experts to ensure that hazards are identified and necessary administrative and engineering controls are implemented as required in the General Safety Plan.



## **F. Environmental Monitoring**

Environmental monitoring will continue to meet DOE and regulatory requirements through the course of the NTLF closure process.

### **F.1 Emissions monitoring**

Stack monitoring at the NTLF required to meet EPA NESHAPs requirements as described in the NESHAP Quality Assurance Project Plan will continue throughout the closure activities as described in the NESHAP Quality Assurance Project Plan. Monitoring of sewer effluents to comply with EBMUD requirements will likewise continue as described in the Environmental Monitoring Plan throughout the closure activities.

### **F.2 Environmental investigation**

The investigation of tritium levels in environmental media (soil, sediment, surface water, ground water) under the site Environmental Restoration Program (ERP) will continue throughout the closure activities. This investigation is carried out under the requirements of the DOE, in accordance with the Resource Conservation and Recovery Act (RCRA).

### **F.3 CERCLA monitoring**

In August 1998, the U.S. Environmental Protection Agency, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), defined Berkeley Lab as "eligible" for its Superfund National Priorities List (NPL). While existing data indicate that tritium emissions at Berkeley Lab are far below U.S. Clean Air Act public health standards, and do not indicate that Berkeley Lab meets criteria for Superfund listing, EPA had requested additional sampling of the air, water, sediment and soil in and around the Laboratory in order to make a final listing decision. That sampling was carried out under an approved Tritium Sampling and Analysis Plan (see <http://www.lbl.gov/ehs/taskforce/>). After reviewing the environmental sampling data, the EPA concluded in July, 2002 that (1) tritium levels at Berkeley Lab are well below federal health standards, (2) Berkeley Lab will not be placed on the federal National Priorities List and (3) no further federal Superfund response action is required.



## **G. Routine Procedures**

EH&S Procedures referenced in this work plan are listed below.

### **G.1 Surveys**

EH&S Procedure 710, Radiological Survey Techniques

### **G.2 Release**

EH&S Procedure 708, Release of Potentially Contaminated Materials & Equipment

### **G.3 Decontamination**

Surfaces will be decontaminated using soap and water or commercial cleaning materials such as Radiacwash or Windex.

### **G.4 Waste**

EH&S Procedure 868, Release of Hazardous Waste from Radiological Materials Areas

EHS Procedure 820, Hazardous, Radioactive, Mixed Waste Acceptance Criteria: Characterization and Compliance

EH&S Procedure 817, Waste Characterization Quality Assurance Program

EH&S Procedure 827, Onsite Transportation of Radioactive Waste

### **G.5 Transportation**

EH&S Procedure 750, LBNL Radioactive Material Transportation Program

### **G.6 Radiological Work Authorization (RWA)**

EH&S Procedure 707, Radiological Work Authorization Program.

### **G.7 Radiation Work Permit (RWP)**

EH&S Procedure 705, Radiation Work Permit Program.



## **Appendix 1 Phase 1 Closure Activities**

### **Nonradioactive chemical clean out of 102/106**

Any excess chemicals in room 75-106 will be transferred to room 75-102.

For clean out of excess chemicals in 75-102, the project will proceed as follows (using subcontractor Clean Harbors):

#### *Clean Harbors initial scope:*

1. Verify physical chemical inventory against the LBNL Chemical Inventory Database
2. Identify and list any chemicals found that are not on the inventory list
3. Classify all chemicals by DOT Hazard Class and packaging requirements
4. Physically sort and segregate all chemicals into approved, labeled accumulation containers according the above-determined DOT classifications / chemical compatibility groups.
5. Fill out LBNL Hazardous Waste Disposal Requisitions for entry into the WM tracking system

#### *WM Certification/Compliance Staff:*

1. Process Hazardous Waste Requisitions per Procedures 820 and 817
2. Review swipe results and internal volume analysis results for conformance to release procedures
3. Notify WM Operations staff of any containers that will need to be managed for radioactive contamination, otherwise, notify Clean Harbors to proceed with packing and shipment



*LBNL Waste Management Operations Technicians:*

1. Based on instructions from the WM Certification/Compliance staff, all containers will be swiped for release per standard WM procedures (Procedure 868)
2. Specific containers that are identified for internal volume sampling will be sampled per standard WM procedures
3. All containers will be double bagged and individual hazardous waste labels will be applied during the above operation
4. Any containers that are identified as non-releasable will be further processed as potential mixed / rad waste.

*Chemical clean out of 103/107*

It has been determined via sampling that the bulk of chemicals stored in these areas are contaminated with tritium. Therefore, chemicals stored in these rooms will be packaged and dispositioned by the HWHF staff as radioactive or mixed waste. Chemicals stored in the cabinets outside room 107 will be tested for tritium and dispositioned accordingly (recycle for use at other labs if free of radioactivity, disposal as mixed or hazardous waste).

**Removal of process material**

NTLF staff in conjunction with HWHF staff will characterize and dispose of process material, primarily tritium labeled compounds that are stored in the lab. These materials will be sent to other users or disposed of as mixed or radioactive waste.

**Tritium Transfer to LLNL**

As part of the NTLF closure process LBNL proposes to transfer the stock supply of tritium used for research at NTLF to the tritium facility at LLNL. Removal and transfer of tritium from the NTLF has been efficiently accomplished in the past as a part of routine operations when new stock tritium is received. Most recently in spring 2001 tritium was received from the DOE Savannah River Site (SRS) and NTLF recycled



tritium was returned to SRS. Similarly, in 1998 a transfer of NTLF recycled tritium was completed to LLNL.

NTLF tritium will be transferred to LLNL in a certified UC-609 DOT Type B shipping container provided by LLNL. LLNL qualified Materials Management personnel will ship the empty UC-609 from LLNL to LBNL. LLNL tritium-qualified personnel will complete the packaging of the uranium beds into the container, and the container will then be returned to LLNL by LLNL Materials Management personnel via government truck. At LLNL the tritium will be added to the inventory at the LLNL tritium facility.

when: November – December 2001

amount: 12,000 curies (~1.2 gram)

form: stored as a solid (tritide) on uranium beds

volume: approximately 0.5 cubic foot (total)

weight: UC 609 weight ~ 500 pounds

The tritium will be packaged and certified as per DOT requirements. Qualified LLNL workers will do the transfer in a government vehicle. The truck will be inspected to ensure proper operation. A commercial carrier will not be used.

This will be a NMMSS reportable transaction. LBNL will report the transfer and quantity based on its most recent calorimeter assays of the tritium activity on the uranium beds.



## Appendix 2 Phase 2 Closure Activities

Phase 2 closure activities will be performed by both LBNL and by a sub-contractor, Scientech, Inc. This phase will consist of purging of the tritium vacuum system, dismantling and disposing (or packaging for reuse elsewhere) the research apparatus and in-lab support systems, and a final release survey. The main components of phase 2 are:

1. **Purging the tritiation vacuum system.** The tritiation vacuum system will be purged of residual tritium, which will be trapped in the emissions control system. The purging will be performed by LBNL staff prior to dismantling of the tritiation vacuum system. The process of purging will consist of sequential flushing of the vacuum system with air, and pumping of the air through the primary clean-up system for capture of tritium released from the system. The goal of the purging is to render the vacuum system safe for disassembly.
2. **Removal of tritiation equipment.** The tritiation equipment and the emissions control system will be dismantled and packaged for shipment either for reuse elsewhere or as low-level radioactive waste. LBNL staff will dismantle much of the apparatus to be reused elsewhere. A subcontractor will then dismantle the remainder of the apparatus and remove other laboratory equipment as indicated below.
3. **Removal of other laboratory equipment.** Fume hoods, benches, sinks, a kiln, glove boxes, and heating, ventilation, and air conditioning (HVAC) equipment, sinks and drains within the rooms 75-103 and 75-107 (but not including rooftop equipment) will fall into this category. Note: rooms 75-102 and 75-106 will not be deconstructed.
4. **Decontamination of rooms 75-103 and 75-107.** The decontamination will include floors, walls, and ceilings. Preliminary surveys will be carried out to identify any areas requiring decontamination. Decontamination will be done primarily by washing with soap and water or commercial cleaners such as Windex, 409, or Radiacwash.
5. **Final release survey.** A final survey of the NTLF will be performed to assure that the facility meets release standards. Survey planning and implementation will in



general follow the guidance of the Multi-agency Radiation Survey and Site Investigation Manual (MARSSIM).

6. **Closure report.** A closure report will be prepared to document the final condition of the facility.



## **Appendix 3 Phase 3 Closure Activities (to be prepared)**